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GB 0655987	US 4296602	US 4132901
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(58) Field of search
F1S
Selected US specifications from IPC sub-class F03B

(54) Wave power machine

(57) The machine comprises a platform 1 having upstanding side walls 2–5 which converge rearwardly from an open mouth 6. The walls are part submerged in the water such that waves entering the mouth 6 pass between the walls 2–5 where the magnitude and duration of the waves increases. The waves then travel up a ramp 7 to lift a hinged flap 8 which is operably coupled to a water pump (13, Fig. 2) mounted beneath the rear of the platform 1*a*. The pump discharges into a chamber (12) to compress air therein and a continuous flow of water may be supplied from the chamber (12) by the compressed air to drive power means such as a turbine.

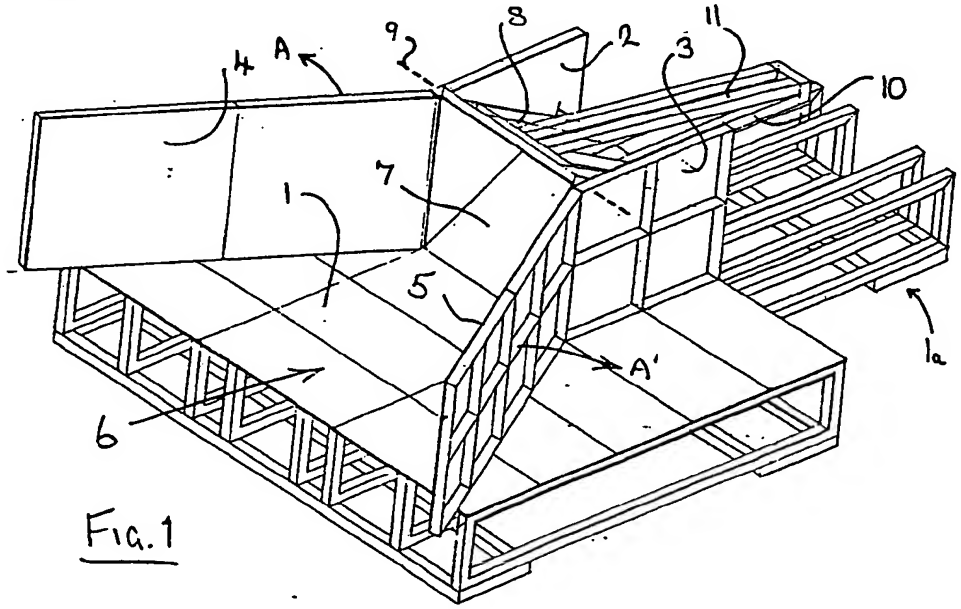

Fig. 1

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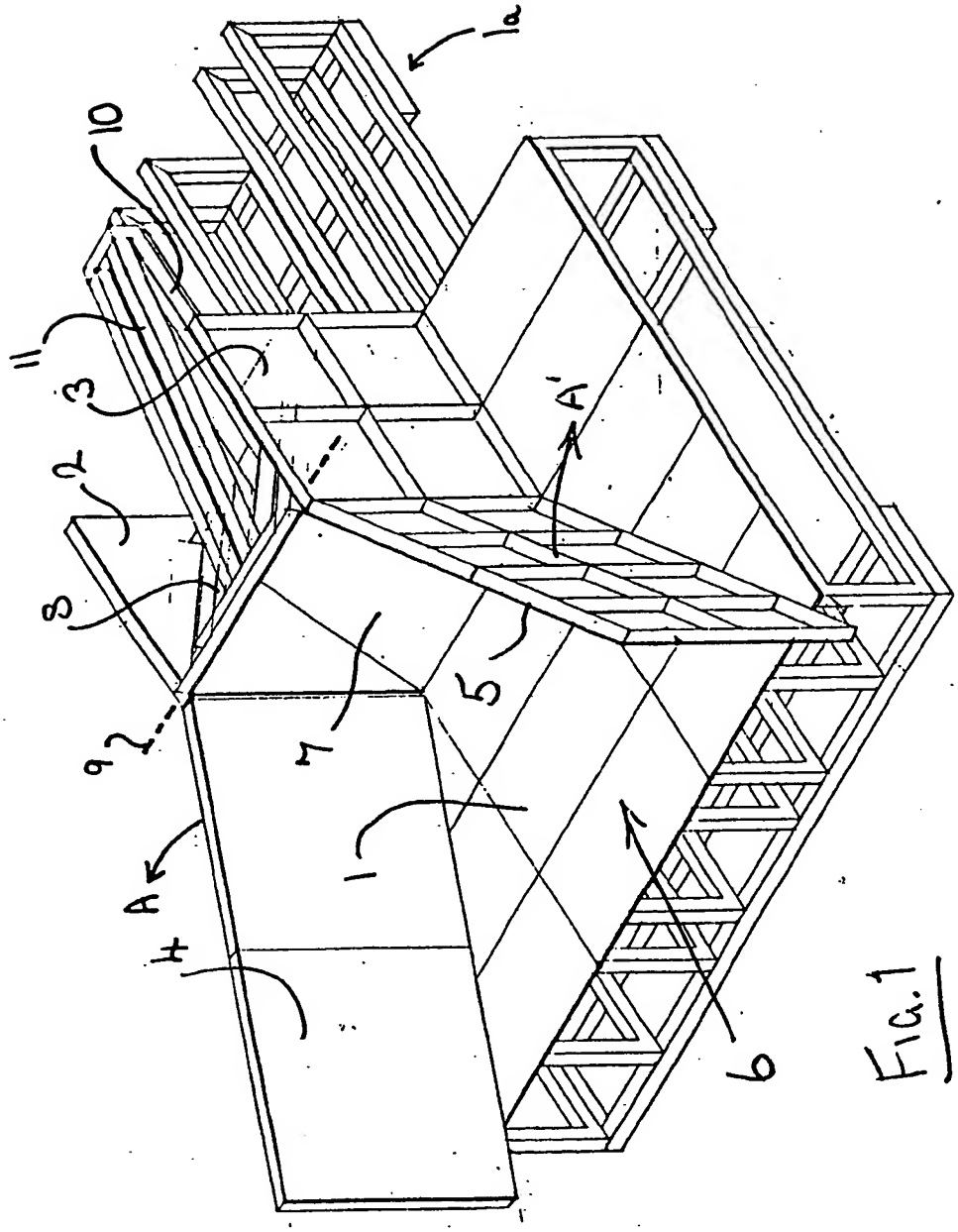

Fig. 1

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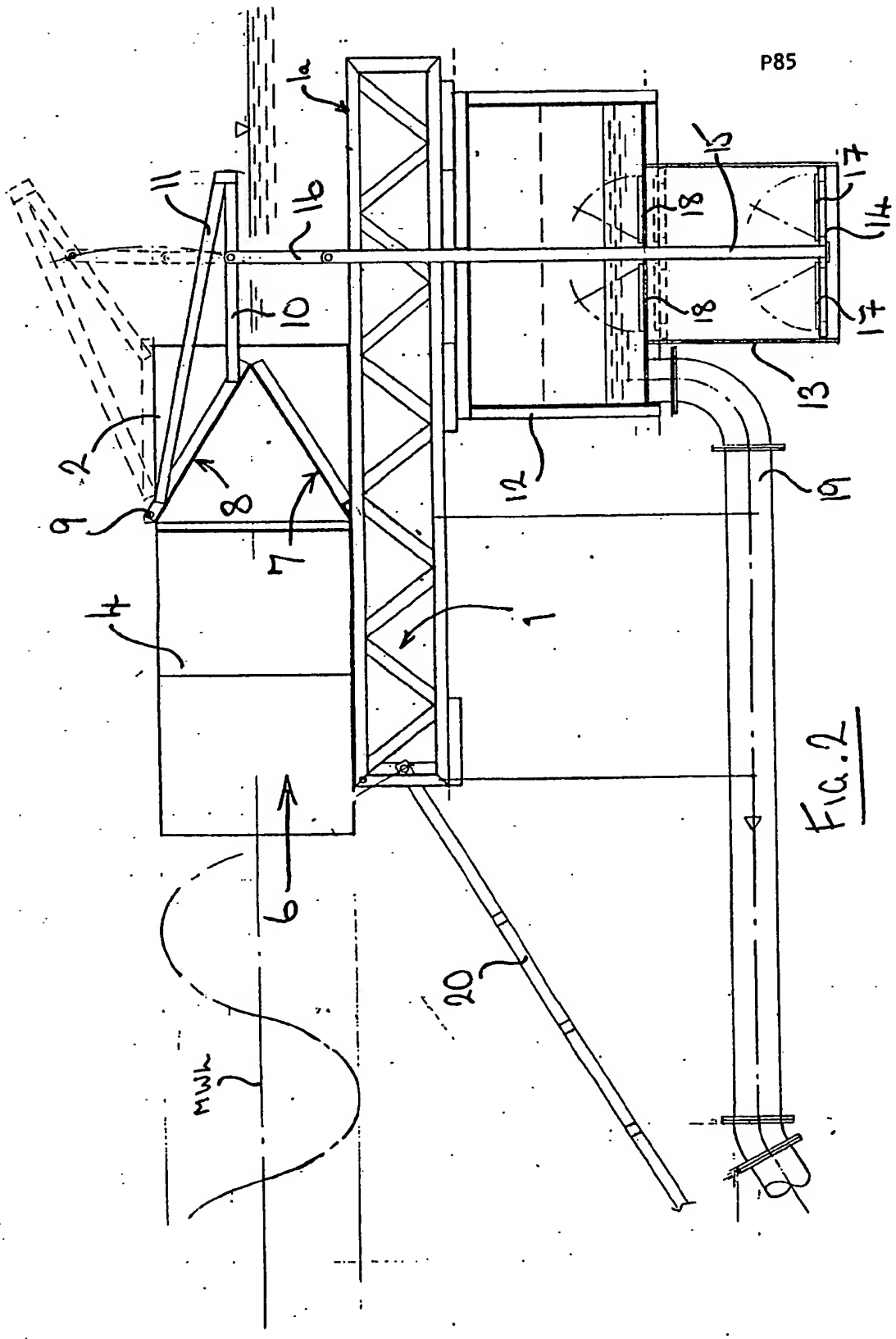

FIG. 2

SPECIFICATION

Wave power machine

Many of the machines previously proposed for harnessing the power of waves in a large body of water such as a sea or lake mainly derive energy from the up-and-down motion of the waves. The present machine is designed to also make use of the forward motion of the waves so that the efficiency of the machine is much improved.

This invention provides a wave power machine comprising a pair of upstanding walls which in use are disposed above and below the mean wave level, the said walls defining between them an open ended passage with an open mouth at the forward end of the passage for directing into the oncoming waves so that waves entering the mouth travel along the passage, the said walls including portions which mutually converge in a rearward direction, a movable member being disposed within the said passage towards the rearward end thereof for movement by the waves as they travel through the passage, and power take off means operably coupled to the said movable member.

The movable member is preferably a hinged flap arranged for movement by the waves, the flap preferably being downwardly inclined in a rearward direction. The passage preferably has a floor which is upwardly inclined to meet the movable member. The power take off means may comprise a water pump.

The invention includes any novel combination of the features disclosed herein.

The invention will now be exemplified in the following description to be read in conjunction with the accompanying drawings in which:

Figure 1 is a perspective view of the main body of the machine, and

Figure 2 is a longitudinal section through the machine.

Referring to Fig. 1, the machine comprises a flat rectangular platform 1 provided with buoyancy tanks or other means of adjusting the buoyancy of the machine (not shown). Two parallel upstanding walls 2, 3 are secured to the rear of the platform parallel to but spaced inwardly form the edges of the platform. Two further upstanding walls 4, 5 define an open mouth 6 at the front of the platform and converge towards the walls 2, 3. These convergent walls are pivoted about a vertical axis (not shown) at the front of the platform They can thus move from a normal position as shown in which their rear edges meet the front edges of walls 2, 3, towards a more parallel position, as indicated by arrows A, A'.

The walls 2, 3 are joined by a flat ramp 7, the front edge of which is joined to the platform 1 and which is upwardly inclined in a rearward direction. The rear edge of the ramp is disposed approximately half way up walls 2, 3 (see Fig. 2) which in use is closely adjacent to mean wave level (MWL). A flat flap 8 is pivoted about a horizontal axis 9 at the top front corners of walls 2, 3, and in its normal position the flap is downwardly inclined so that its rear edge meets the rear edge of ramp 7. The flap can however pivot upwardly to a generally horizontal position shown in outline in Fig. 2. An arm 10 is rigidly secured to the lower edge of flap 8 to extend rearwardly when the flap is in its lower position. Bracing 11 joins the outer end of arm 10 to the top edge of flap 8. A float (not shown) may be connected to the free end of arm 10 to reduce the force required to lift flap 8.

As shown in fig. 2, a compression chamber 12 is mounted beneath an extension section 1a which projects from the rear end of platform 1. A smaller cylindrical pump chamber 13 is in turn mounted below the compression chamber 12. The pump chamber is open at its lower end and contains a vertically reciprocable piston 14 connected to a piston rod 15. The rod extends sealably through the chamber 12 and is pivoted to a linkage 16 which is in turn pivoted part way along arm 10. Piston 14 contains one way valves 17 which close on the upward stroke of the piston but open on the downward stroke to permit the chamber 13 to fill with water. Similar valves 18 are disposed between chambers 12 and 13 to permit a unidirectional flow of water from chamber 13 to chamber 12. An outlet pipe 19 is connected to the lower wall of chamber 12.

Since the machine is designed to operate in tidal waters the front of platform 1 is pivoted to the wider end of a rigid A-frame 20 which is in turn rotatably pivoted at its narrow end about a horizontal axis to an anchorage point on the sea bed. Thus, the platform is able to move up and down with the tides. The frame is also able to rotate freely about a vertical axis at the anchorage point so that the mouth 6 of the machine is always directed into the oncoming waves.

In use, the buoyancy tanks are filled to such an extent that the machine floats at the sea surface with the mean sea level MWL about half way up walls 2-5. The rigid A-frame 20 permits the platform 1 to ride up and down but prevents back and forth motion along the surface of the sea. When a wave passes through mouth 6 the height of the wave is increased by the convergent walls 4, 5, but even more importantly, the duration of each wave crest is prolonged. Thus, when the wave impinges on flap 8 it tends to impart a sustained force on the flap rather than a short shock wave. The ramp 7 serves to deflect the wave towards the flap 8 so that as the wave passes rearwardly between walls 2 and 3 it experiences multiple reflections between the flap and ramp. Thus, the amount of energy imparted to the flap is optimised. As a result,

the flap 8 is subjected to a sustained lifting force which is transmitted to piston 14 via arm 10, linkage 16 and rod 15. Upward movement of the piston expels the contents of the pump chamber 13 through valves 18 into chamber 12 which causes an air space in the upper portion of the compression chamber 12 to be compressed. When the wave has passed, the flap 8 closes and piston 14 returns to its lower position allowing the chamber 13 to fill via valves 17. Meanwhile, the air pressure built up in chamber 12 causes valves 18 to close followed by a sustained expulsion of water through pipe 19. Thus, although the pump action of piston 14 is intermittent the flow of water through pipe 19 may be continuous provided the waves are of sufficient magnitude and frequency. This flow may be used to drive a turbine or other means of power generation, either directly or via a storage reservoir.

In non-tidal waters the machine could be rigidly mounted off the sea bed, e.g on pillars, and again the machine would be arranged so that the mouth of the passage is always directed into the oncoming waves.

In very rough seas the walls 4, 5 may be pivotally moved apart by any convenient means to reduce the volume and force of the waves passing between walls 2, 3. Ramp 7 could also be pivoted at the front edge so that it can be moved towards a horizontal position for a similar purpose.

CLAIMS

1. A wave power machine comprising a pair of upstanding walls which in use are disposed above and below the mean wave level, the said walls defining between them an open ended passage with an open mouth at the forward end of the passage for directing into the oncoming waves so that waves entering the mouth travel along the passage, the said walls including portions which mutually converge in a rearward direction, a movable member being disposed within the said passage towards the rearward end thereof for movement by the waves as they travel through the passage, and power take off means operably coupled to the said movable member.

2. A machine according to Claim 1, in which the said walls are upstanding from a floor of the passage.

3. A machine according to Claim 2, in which the floor includes a portion which is upwardly inclined in a rearward direction.

4. A machine according to any preceding claim, in which the movable member comprises a flap which is arranged for movement by the waves about a substantially horizontal pivot axis.

5. A machine according to Claim 4, in which the flap is downwardly inclined in a rearward direction.

6. A machine according to Claim 4 or 5 as appended to Claim 3, in which the rearward end of the upwardly inclined portion of the passage floor meets the rearward end of the flap.

7. A machine according to any preceding claim, in which the power take off means comprises a water pump.

8. A machine according to Claim 7, in which the pump comprises a piston reciprocable in a cylinder defining a pumping chamber, the piston being operably coupled by a piston rod to the said movable member, and valve means being provided for permitting unidirectional movement of water into the cylinder on reciprocation of the said piston.

9. A machine according to Claim 8, in which further valve means are provided for permitting unidirectional movement of water from the pumping chamber into a compression chamber which includes an air space, the compression chamber having an exit opening for the water.

10. A machine according to Claim 9, in which the compression chamber is located above the pump chamber and the piston rod passes sealably through the compression chamber.

11. A machine according to any preceding claim, in which the said walls of the passage are upstanding from a platform.

12. A machine according to Claim 11, in which the platform is provided with buoyancy adjustment means.

13. A machine according to any preceding claim including means for automatically varying the orientation of the machine such that the mouth of the passage is always directed into the oncoming waves.

14. A machine according to any preceding Claim, in which the machine includes means for anchoring to the bed of a body of water.

15. A machine according to Claim 14, in which the said anchoring means is rigid.

16. A machine according to Claim 15 as appended to Claim 11, in which the rigid anchoring means is pivoted to both the platform and the bed to permit the body to move up and down in the water.

17. A machine according to Claim 16, in which the rigid anchoring means is pivoted to the bed for movement about a substantially vertical axis.

18. A machine according to Claim 16 or 17 as appended to Claim 11, in which the rigid anchoring means is pivoted to the platform at two spaced positions.

19. A wave power machine substantially as described with reference to the accompanying drawings.

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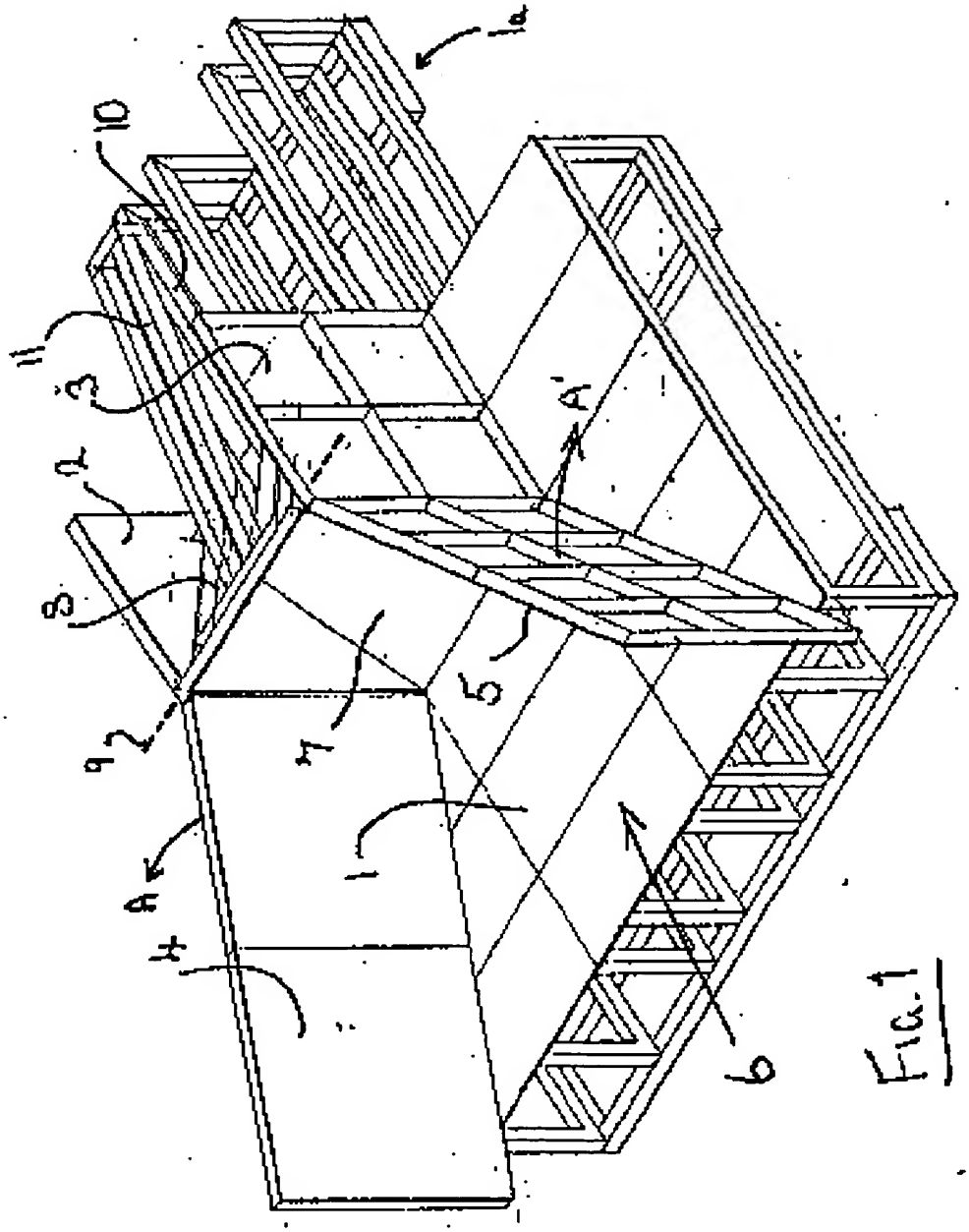

Fig.1

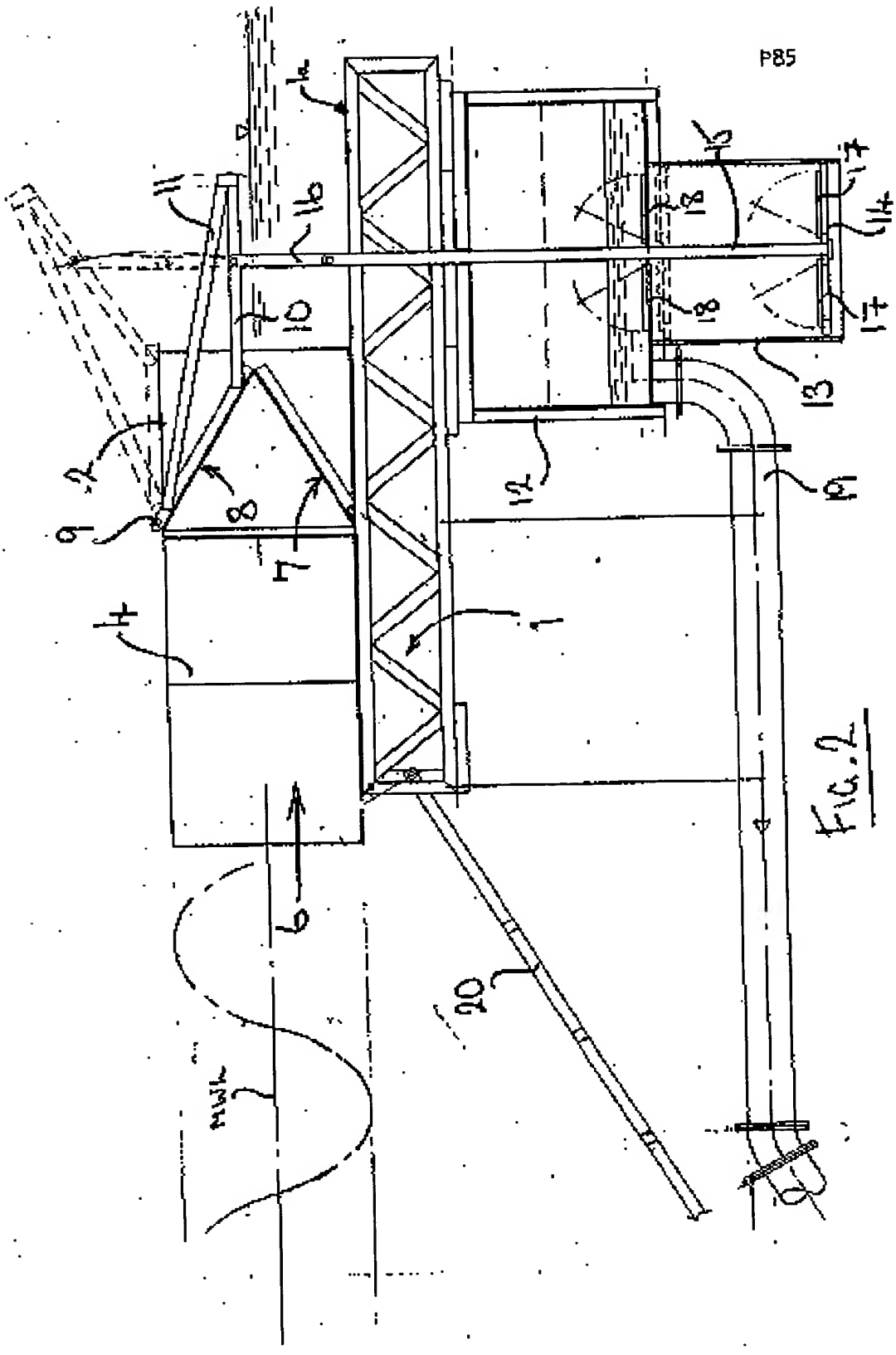

FIG. 2